



**FACULTY OF MECHANICAL ENGINEERING KRALJEVO
UNIVERSITY OF KRAGUJEVAC
KRALJEVO – SERBIA**

THE SEVENTH INTERNATIONAL TRIENNIAL CONFERENCE

HEAVY MACHINERY HM 2011

PROCEEDINGS

Vrnjačka Banja, June 29th – July 2nd 2011.



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PREFACE

The Faculty of Mechanical Engineering Kraljevo has been traditionally organizing the international scientific conference devoted to heavy machinery every three years. The VII International Scientific Conference HM 2011 is considering modern methods and new technologies in the fields of transport design in machinery, control energy, production technologies, urban engineering and civil engineering through thematic sessions for the purpose of sustainable competitiveness of economic systems. Modern technologies are exposed to fast changes at the global world level so that their timely application both in large industrial systems and in medium and small enterprises is of considerable importance for the entire development and technological progress of economy as a whole.

The VII International Scientific Conference Heavy Machinery HM 2011 is a place for exchange of experiences and results accomplished in domestic and foreign science and practice, with the goal to indicate directions of further development of our industry on its way toward integration in European and world economic trends. Exchange of experiences between our and foreign scientific workers should contribute to extension of international scientific-technical collaboration, initiation of new international scientific-research projects and broader international collaboration among universities.

The papers which will be presented at this Conference have been classified into seven thematic fields:

- A. Railway Engineering
- B. Earth-Moving and Transportation Mechanization
- C. Automatic control and fluid technique
- E. Mechanical Design and Mechanics
- F. Production Technologies
- G. Urban Engineering
- H. Structures And Materials In Civil Engineering

Within this Conference, the First International Students Symposium will be held. The aim is to open a scientific discussion on this actual problem in industry among young students.

The sponsorship by the Ministry of Science of the Republic of Serbia is the proper way to promote science and technology in the area of mechanical engineering in Serbia.

On behalf of the organizer, I would like to express our thanks to all organizations and institutions that have supported this Conference. I would also like to extend our thanks to all authors and participants from abroad and from our country for their contribution to the Conference. And last but not the least, dear guests and participants in the Conference, I wish you a good time in Kraljevo – Vrnjačka Banja and see you again at the Eight Conference, in three years.

Kraljevo – Vrnjačka Banja, June 2011

Conference Chairman,

Prof. Dr. Novak Nedić, mech eng.

CONTENTS

PLENARY SESSION

B. Jerman, M. Čuk, F. Resman, T. Popit, S. Štih FINITE ELEMENT ANALYSIS OF SANDWICH PANELS WITH OPENINGS	1-12
Z. Djinovic, M. Tomic FIBER OPTIC SENSING TECHNOLOGY FOR HEALTH MONITORING OF HEAVY STRUCTURES	13-24
D. Radojevic LOGICAL AGGREGATION AND REAL-VALUED REALIZATION OF FINITE BOOLEAN ALGEBRA	25-29
N. Nedić, D. Petrović, D. Pršić, M. Djapić, S. Ćirić-Kostić, Lj. Lukić INTERNATIONAL SCIENCE AND TECHNICAL COOPERATION OF THE FACULTY OF MECHANICAL ENGINEERING IN KRALJEVO	31-40

A SESSION: RAILWAY ENGINEERING

D. Atmadzhova THE WHEEL FLAT – RAIL INTERACTIONS	1-8
D. Petrović, M. Bižić, M. Đelošević, R. Rakanović IDENTIFICATION OF WAVE PHENOMENA AT WAGONS IMPACT	9-12
B. Benchev, V. Stoyanov APPLICATION OF REGRESSION ANALYSIS IN STUDYING THE INTERACTION OF TERRESTRIAL VEHICLES WITH ROAD	13-15
V. Nikolov STUDY OF NOISE CHARACTERISTICS OF THE BRAKE BLOCKS RELATED WITH ROUGHNESS OF THE WHEEL TREAD	17-20
A. Dzhaleva-Chonkova WAGON MANUFACTURING AND MAINTENANCE IN THE BALKANS. PART 2: ROMANIA, TURKEY AND OTHER COUNTRIES	21-24
Lj. Lukić, M. Djapić TRANSPORTATION AND MANIPULATION PROCESSES IN THE OVERHAUL OF ENERGY TRANSFORMERS	25-32
N. Bogojević, P.-A. Jönsson, S. Stichel IRON ORE TRANSPORTATION WAGON WITH THREE-PIECE BOGIES – SIMULATION MODEL AND VALIDATION	33-38

E. Dimitrov, N. Nenov MEASURING RAILWAY VEHICLE WHEEL LOAD IN MOTION	39-42
Z. Damianova, A. Dzhaleva-Chonkova, N. Nenov, N. Nedic NETWORKING AS A TOOL FOR SUPPORTING RESEARCH IN THE BALKAN REGION (THE CASE OF SURFACE TRANSPORT)	43-47
E. Mihaylov, D. Atmadzhova STUDY ON WHEEL PROFILE OF TRAM IN OPERATION	49-54
M. Mihalev, D. Atmadzhova DEVELOPMENT OF THE METHODS OF THE ANALYSIS BEHAVIOR OF THE HOPPER CARS AND DETERMINATION OF THE PERIOD TO OPERATION EXPLOITATION FOR TRANSPORTATION CORROSION -ACTIVE MATERIALS	55-61
T. Kachaunov, Z. Trendafilov SIMULATION MODELING OF TRAIN SERVICE WITH LOCOMOTIVES	63-65

B SESSION: EARTH-MOVING AND TRANSPORTATION MACHINERY

I.I. Nazarenko, A.T. Sviderski, O.P. Dedov DESIGN OF NEW STRUCTURES OF VIBRO-SHOCKING BUILDING MACHINES BY INTERNAL CHARACTERISTICS OF OSCILLATING SYSTEM	1-4
И.А. Емельянова, А.А. Задорожный, А.С. Непорожнев, С.А. Гузенко EFFICIENCY OF DOUBLE-PISTON PUMPS FOR CONCRETE APPLIED TO BULKY CONCRETE MIXTURES AT THE BUILDING SITES	5-10
И.А. Емельянова, В.В. Блажко, А.И. Анищенко, О.В. Доброходова ANALYSIS OF THE OPERATION OF CONCRETE MIXER WITH GRAVITATIONAL AND FORCED ACTION	11-14
А.И. Доценко WEAR FATIGUE DEFECTS OF VIBRATION EQUIPMENT IN INDUSTRY OF REINFORCED CONCRETE	15-18
I.Kirichenko THE ANALYSIS OF SIGNIFICANCE OF DESIGN AND OPERATIONAL PARAMETERS THAT AFFECT THE PRODUCTIVITY OF EARTHMOVING MACHINES	19- 22
P. Bratu, C. Debeleac THE ANALYSIS OF VIBRATORY ROLLER MOTION	23-26
C. Francu, A. Bruja, M. Dima SELF-ERECTING CRANE SIMULATION WHILE RAISING AND LOWERING STAGES	27-32
A. Poliarus, E. Poliakov IMPROVING THE INFORMATION ACCURACY IN BUILDING AND ROAD MACHINES	33-36

E. Lazarevska, J.Trpovski FUZZY-NEURAL APPROACH TO MODELING A TOWER CRANE	37-42
R. Petrova, S. Dechkova MODAL ANALYSIS OF AN AERIAL MONO-CABLE CHAIR-ROPEWAY	43-48
M. Gašić, M. Savković, G. Marković, N. Zdravković, M. Nikolić CONSTRUCTION PERFORMANCES OF BUILDING AND TRANSPORT MECHANIZATION REVOLVING SUPPORT	49-54
S. M. Bošnjak, Z. D. Petković, G. Z. Milojević, V. M. Mihajlović THE DESIGN – IN FAULTS AS A CAUSES OF THE HIGH PERFORMANCE MACHINES FAILURES	55-60
N. Đ. Zrnić, M. D. Đorđević, Z. D. Petković, S. M. Bošnjak ECO ISSUES IN BELT CONVEYING TECHNOLOGIES	61-66
V. Gašić, N. Zrnić, M. Milovančević IN-PLANE VIBRATIONS OF THE GANTRY CRANE STRUCTURE DUE TO A LOAD MOVING WITH CONSTANT SPEED	67-72
M. Jovanović, G. Radoičić, T. Maneski DYNAMICAL EIGENVALUE IDENTIFICATION OF HEAVY STRUCTURES MACHINE	73-78
M. Jovanović, G. Radoičić INCIDENTAL BEHAVIOR OF THE STRUCTURE WITH REDUCED TECHNICAL CORRECTNESS	79-84
D. Janošević, N. Petrović, P. Milić, V. Nikolić MODELLING RESISTANCE OF DIGGING OF HYDRAULIC EXCAVATORS	85-88
M. Popović, Z. Jugović, R. Slavković, N. Grujović, I. Milićević, J. Borota INTEGRATED APPROACH OF CUTTING TEETH DESIGN IN EXCAVATOR OF CONTINUAL ACTION	89-98
R. Vasiljević, Z. Petković, S. Bošnjak APPLYING FINITE ELEMENT METHOD FOR RESEARCH STATIC AND DYNAMIC PROPERTIES OF ELECTRO-MECHANICAL TWO POST LIFT	99-104
M. Čupović, M. Gašić, M. Savković, N. Zdravković, D. Jovanović DYNAMIC LOADS EFFECTS ON THE CHARACTERISTICS OF COMPRESSIVE MONOCABLE CHAIRLIFT TOWERS	105-110
M. Savković, M. Gašić, N. Zdravković, G. Marković SPECIAL DESIGN OF FREIGHT ELEVATOR WITH DIAGONAL GUIDING AND INSTANTANEOUS TYPE ECCENTRIC SAFETY GEAR	111-116
Z. Petrović, U. Bugarić, D. Petrović USAGE OF MOVABLE LASER AND PHOTO ELECTRIC SCREEN FOR CRANE RAILS MEASUREMENT	117-120

S. Jovanović, A. Đurić, D. Repajić ONE APPROACH IN TESTING PIONEER MACHINES	121-125
--	---------

C SESSION: AUTOMATIC CONTROL AND FLUID TECHNIQUE

N. Nedic, V. Filipovic, S. Prodanovic AUTO-TUNING OF PID CONTROLLER FOR SYSTEM TURBINE- CONDENSER IN THE THERMAL POWER PLANT	1-6
V. Filipovic, V. Stojanovic: Switching Predictive Control CONTROLLER DESIGN AND SIMULATIONS	7-12
M. Stojcic DESIGN OF ELECTROMECHANICAL POSITIONING SYSTEMS WITH CONTROLLED JERK	13-17
V. Djordjevic, D. Prsic, R. Bulatovic OPTIMIZATION OF THE PARAMETERS OF PID CONTROLLER ON THE MODEL OF INVERTED PENDULUM BY USING ALGORITHM OF PARTICLE SWARM OPTIMIZATION	19-26
D. Nauparac THE CRITERIA OF CONTROL ALGORITHMS FOR ELECTRO-HYDRAULIC POWER ACTUATOR	27-32
V. Brasic, Lj. Dubonjic THE METHOD FOR EXTRACTING REGION OF ABSOLUTE STABILITY-LOOP- CONTROLLED TIME DELAY SYSTEMS	33-36
Lj. Dubonjic, V. Brasic SEPARATION OF CONSTANT SETTLING TIME AREA WITH D-COMPOSITION METHOD FOR CONTROLLED TIME DELAY SYSTEMS	37-40
D. Prsic, N. Nedic, Lj. Dubonjic MODELING AND SIMULATION OF HYDRAULIC LONG TRANSMISSION LINE BY BOND GRAPH	41-46
V. Stojanovic, V. Filipovic, N. Nedic STOCHASTIC MODEL OF A PNEUMATIC ACTUATOR	47-52
S. Biocanin, D. Golubovic, R. Bozickovic, M. Pavlovic DETERMINATION OF THE OPTIMAL STRATEGY FOR PREVENTIVE MAINTENANCE OF THE CONTROL BLOCK OF SPECIAL PURPOSE VEHICLE	53-58
Z. Glavicic ON SOME ENERGY LOSSES AND FLOW ENERGETIC PARAMETERS OF TRANSITIONS REGIMES OF HYDRODYNAMIC PROCESSES OF PUMPS	59-62
J. Vujakovic, M. Rajovic SOME LINEARITY CHARACTERISTICS FOR HOMOGENEOUS VEKUA EQUATION WITH ANALYTICAL COEFFICIENT	63-66

D SESSION: DESIGN AND MECHANICS

A. Bruja, M. Dima, C. Francu GEARING LINE AND GEARING PROFILE OF PRECESSIONAL GEARING DETERMINED BASED ON THE FUNDAMENTAL LAW OF GEARING	1-5
S. Karapetkov, I. Moneva, M. Gramenova, M. Tsoneva MECHANO-MATHEMATICAL MODELING OF MOTOR-VEHICLE MOTION WITH READING THE STABILIZING MOMENT OF THE DRIVING WHEELS	7-12
Z. D. Petković, S. M. Bošnjak, N. B. Gnjatović, I. LJ. Milenović THE DESIGN AND REDESIGN OF MECHANIZED SLIPWAYS	13-18
C. Mladenović, S. Tabaković, Milan Zeljković DESIGN OF 3-DOF MACHINE TOOL BASED ON HYBRID MECHANISM	19-24
M. Dima, A. Bruja, C. Francu DETERMINATION OF THE MESHING FORCES OF GEARING TEETH WITH PRECESSION MOVEMENT	25-29
J. Stefanović-Marinović, M. Milovančević, B. Anđelković PLANETARY GEAR TRANSMISSIONS OPTIMIZATION IN THE CASE OF THE PARTICULAR CRITERIA PREFERENCES	31-36
R. Ćirić, B. Savić, Z. Jugović, R. Slavković, N. Dučić CHARACTERIZATION OF THE PROPERTIES OF EXPOLISION PROCESSED MATERIALS FOR THE CONSTRUCTION OF MINING PARTS EXPOSED TO ABRASION	37-42
Z. Dančuo, V. Kvirgić, R. Milićević, V. Zeljković STRUCTURE OF CENTRIFUGE FLIGHT SIMULATION	43-48
M. Arsić, B. Vistić, Z. Savić, Z. Odanović, M. Mladenović TURBINE SHAFT FAILURE CAUSE ANALYSIS	49-54
A. Ilić, L. Ivanović, D. Josifović, Z. Jugović STRESS CONCENTRATION AT WELDED JOINS OF BUCKET-WHEEL EXCAVATOR	55-60
S. Ćirić Kostić, M. Ognjanović, A. Vranić EFFECT OF DESIGN PARAMETERS TO MODAL BEHAVIOUR OF GEAR UNIT HOUSINGS	61-67
A. Nikolic, R. Bulatovic OPTIMIZATION OF KINEMATIC CHARACTERISTICS OF GENEVA MECHANISM	69-74
Z. Šoškić, S. Ćirić Kostić, N. Bogojević, A. Radovani DETERMINATION OF WORKING REGIME DURING EXPERIMENTAL INVESTIGATIONS OF ROTATIONAL MACHINES	75-80

M. Đelošević, V. Gajić, D. Petrović, M. Bižić DISTRIBUTION OF BENDING MOMENTS ON THE PLATES OF CARRIER WITH TRAPEZOIDAL CROSS SECTION	81-84
S. Šalinić MODELING OF FLEXIBLE PLANAR STRUCTURES BY A SYSTEM OF RIGID BODIES	85-90
Lj. Lalovic, D. Lalovic, J. Knezevic-Miljanovic VEHICLE DYNAMICS IN OVERTAKING	91-94
R. Potočnik, Dž. Kovačević, M. Zadnik, B. Japelj, N. Drvar, T. Hercigonja SETTING UP CAR HOOD TO IMPROVE PEDESTRIAN PROTECTION - TESTS AND MEASUREMENTS WITH THE OPTICAL 3D METROLOGY	95-100

E SESSION: PRODUCTION TECHNOLOGIES

M. Kolarević, M. Vukićević, B. Radičević, M. Bjelić, V. Grković A METHODOLOGY FOR FORMING THE REGRESSION MODEL OF TERNARY SYSTEM	1-6
M. Vukićević, M. Bjelić, M. Kolarević, A. Petrović COMPARISON OF CONVENTIONAL AND ROBOTIC WORKPLACE BASED ON ECONOMIC AND PRODUCTION INDICATORS	7-12
M. Bjelić, M. Vukićević, M. Kolarević, A. Petrović NUMERICAL SIMULATION OF WELDING PARAMETERS INFLUENCE ON TEMPERATURE FIELD DURING GMAW WELDING	13-16
B. Radičević, Z. Petrović, S. Ivanović, M. Georgieva CALCULATION OF FAILURE CRITICALITY IN RELIABILITY - CENTRED MAINTENANCE	17-23
S. Ivanović, Lj. Lukić MODULE FOR UPDATE OF TECHNOLOGICAL PARAMETERS IN POSTPROCESSOR GENERATOR OF NC PROGRAMS IN FLEXIBLE MANUFACTURING SYSTEM	25-30
V. Zeljkovic, M. Veselinovic, M. Djapic, Lj. Lukic FOODSTUFFS MACHINE HARMONIZATION WITH EU REGULATIONS	31-36
Dragoljub Vujić STRUCTURAL HEALTH MANAGEMENT OF COMPLEX ENGINEERING STRUCTURES	37-42
D. Markovic, M. Madic, Z. Marinkovic, V. Tomic, G. Petrovic HARMONY SEARCH AND GENETIC ALGORITHMS FOR ENGINEERING OPTIMIZATION: THEORY AND PRACTICE	43-48
A. Petrović, M. Manić, B. Radičević, Z. Šoškić APPLICATION POSSIBILITIES OF ARTIFICIAL INTELLIGENCE METHODS IN DESIGN FOR ASSEMBLY	49-54

Ž. Jakovljević TIME LOCALIZATION OF ABRUPT CHANGES IN CUTTING PROCESS USING HILBERT HUANG TRANSFORM	55-60
A. Babić, N. Ilić, V. Jakovljević DFX APPROACHES AND CAX TOOLS IN INTEGRATED DEVELOPMENT OF PRODUCTS AND PROCESSES	61-65
N. Nikolić, Lj. Lukić, M. Djapić, G. Stojanović, Z. Petrović COMPUTER INTEGRATED PRODUCTION TECHNOLOGIES	67-72
Z. Petrović, Lj. Lukić, R. Bulatović, V. Đorđević, N. Nikolić OPTIMIZATION OF THE PARAMETERS OF BROACHING MACHINING MODE BY USING THE METHOD OF PARTICLE SWARM OPTIMIZATION (PSO)	73-78
N. Ilić, M. Manić, A. Babić APPLICATION OF AI TECHNIQUES IN DESIGN FOR MANUFACTURING	79-84
M. Pljakić, A. Babić BASIC PRINCIPLES OF ARTIFICIAL INTELLIGENCE IN MODELING ASSEMBLY OPERATIONS IN CAM	85-90
N. Ilić, A. Babić ASSEMBLY PLAN DESIGN IN INTEGRATED DEVELOPMENT OF MILLING HEADS	91-96
M. Pljakić, V. Jakovljević THE INTEGRAL DEVELOPMENT OF PRODUCTS USING THE DFX APPROACHES AND CAX TOOLS	97-102

F SESSION: URBAN ENGINEERING

V. Bacria, N. Herişanu ACOUSTICAL ARRANGEMENT OF THE ROAD SUPERSTRUCTURE	1-6
V. Tomić, Z. Marinković, D. Marković, G. Marković ORGANIZATION OF DISTRIBUTION CENTERS, THE CASE OF "IDEA" NIŠ	7-14
V. Karamarković, R. Karamarković, M. Marašević A REVIEW OF MULTI-STAGE ALLOTHERMAL GASIFIERS	15-24
A. Cupic, G. Markovic, M. Bukumirovic MODERN SYSTEMS OF IDENTIFICATION AND PRODUCTION LOGISTICS MANAGEMENT IN MACHINE BUILDING	25-30
D. Živanić, J. Vladić, R. Đokić, A. Gajić ZONING IN THE ORDER PICKING SYSTEMS	31-34
M. Prašćević, D. Cvetković, D. Mihajlov NAISS MODEL VALIDATION BASED ON MEASURED DATA OF NOISE MONITORING	35-38

D. Cvetković, M. Praščević , D. Mihajlov ESTIMATION OF UNCERTAINTY IN ENVIRONMENTAL NOISE MEASUREMENT	39-44
M. Škurić, B. Dragović, R. Meštrović CONTAINER YARD PERFORMANCE EVALUATION IN PORT	45-50
B. Dragović, N. DJ. Zrnić, M. Škurić ADVANCED SYSTEMS FOR CONTAINER TERMINALS HANDLING EQUIPMENT	51-56
Savo Trifunović THE WORLD OF WORK AND THE NEW SOCIOLOGY OF WORK OR SOPHITRONICS OF WORK?	57-61
G. Marković, Z. Marinković , V. Tomić, A. Čupić LOCATION OF REGIONAL LOGISTIC CENTER: MULTIPLE CRITERIA DECISION MAKING AND IMPLEMENTATION OF ALGORITHMS UNDER FUZZY ENVIRONMENT	63-70
B. Tatić, N. Bogojević, Z. Šoškić, Z. Petrović RAILWAY VEHICLES AS THE SOURCE OF THE NOISE IN THE URBAN AREAS	71-80
Z. Petrović, B. Radičević , M. Praščević, Z. Šoškić NOISE PROTECTED BUILDINGS	81-86

G SESSION: STRUCTURES AND MATERIALS IN CIVIL ENGINEERING

E. Lyubchenko, S. Aksyonova METHODS OF FRICTION OPTIMIZATION BY ADDITION OF NANO-PARTICLE COMPOSITION TO LUBRICANTS	1-5
J. Vladić, R. Đokić, D. Živanić ANALYSIS AND TESTING OF NODAL ELEMENTS ON PREFABRICATED INDUSTRIAL OBJECTS	7-12
M. Dedic, M. Todorovic CALCULATION OF THE FREE END DEFLECTION OF A TRUSS BEAM WITH VARIABLE CROSS-SECTION	13-16
N. Bojić, Z. Jugović, M. Popović, R. Slavković INFLUENCE OF HOLE'S SHAPE ON THE STRESS CONCENTRATION AT A STRESS PLATE BENDING AND TENSION	17-21
D.Minić, Z. Petrović, M. Premović, M. Marković ALLOY CHARACTERIZATION AND LIQUIDUS SURFACE DEFINITION OF TERNARY BI-CU-IN SYSTEM	23-28
G. Mladenovic, M. Popovic DESIGN AND OPTIMIZATION FOR TRUSS CONSTRUCTIONS USING THE SOFTWARE PACKAGE AUTODESK INVENTOR 2011®	29-32

M. Todorovic, M. Dedic AN ANALYSIS OF EQUIVALENT RIGIDITIES OF A TRUSS BEAM	33-38
Miljan Veljovic THE ANALYSIS OF CROSS-SECTIONS AND STABILITY OF COLUMNS CENTRICALLY LOADED BY AXIAL COMPRESSIVE LOAD	39-41
D. Minić, M. Kolarević, M. Premović, M. Marković THERMODYNAMIC CALCULATION OF THE BI-IN-SB PHASE DIAGRAM	43-47
N. Radić, S. Trifković, M. Milutinović ANALYTICAL AND NUMERICAL INVESTIGATION OF LOCAL AND DISTORTION STABILITY LOSS OF THIN WALL PROFILE WITH OPEN CROSS-SECTION	49-54
M. Veljovic, R. Bulatović, V. Đorđević OPTIMIZATION OF THE PLANE TRUSS BY USING THE METHOD OF PARTICLE SWARM OPTIMIZATION (PSO)	55-60

Some linearity characteristics for homogeneous Vekua equation with analytical coefficients

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There are very little data in literature about Vekua equations with analytical coefficients. That is why they present an interesting area of scientific work. It is known (see [1-6]) that they have been solved by analytical substitution method or by a series-iteration method. Basis for these methods is the principle of fixed point.

In this paper we have presented that homogeneous Vekua equation, with analytical coefficients, is only apparently linear. Actually, it is typically transcendental equation.

Keywords: Conjugate derivate, analytical functions, Vekua equation, a series iteration method.

0 INTRODUCTION

Equation

$$\frac{\partial w}{\partial \bar{z}} = Aw + B\bar{w} \quad (1)$$

where $A = A(z, \bar{z})$ and $B = B(z, \bar{z})$ are analytical functions in certain finite region G , is called homogeneous Vekua equation. Operation

$\frac{\partial w}{\partial \bar{z}}$, denoting conjugate derivative,

$$\frac{\partial w}{\partial \bar{z}} = \frac{1}{2} \left[\left(\frac{\partial u}{\partial x} - \frac{\partial v}{\partial y} \right) + i \left(\frac{\partial u}{\partial y} + \frac{\partial v}{\partial x} \right) \right] \quad (2)$$

is linear, so is applicable

$$\begin{aligned} \frac{\partial}{\partial \bar{z}}(w_1 \pm w_2) &= \frac{\partial w_1}{\partial \bar{z}} \pm \frac{\partial w_2}{\partial \bar{z}} \\ \frac{\partial}{\partial \bar{z}}(cw_1) &= c \frac{\partial w_1}{\partial \bar{z}}, c = \text{const.} \end{aligned}$$

Conjugate derivative is very similar to ordinary derivative, so the operational rules for product, quotient are easy to perform, as well as the rules for conjugate derivatives of elementary complex or conjugate complex functions.

If in equation (1) coefficient is $B=0$, then equation (1) is called Theodoresku equation.

With these rules it can be easily transferred to reverse operation to conjugated derivative, that is, integral \int .

In order to more relate this integral to ordinary integral, we are introducing sign

$$\hat{\int} F(z, \bar{z}) = \int F(z, \bar{z}) d\bar{z} + \phi(z),$$

where $\phi(z)$ is arbitrary analytical function in the role of integral constant. This is not line integral, but symbolic record that is necessary to integrate only by one variable \bar{z} , considering second variable z as a constant.

Due to these characteristics, derivatives and integrals, solving of equation (1) was reduced to procedures very similar to solving of ordinary differential equations with real argument. Main difference is because the main role of the ordinary constant here is taken over by arbitrary function $\phi(z)$.

In monograph [1] was pointed out the importance of this equation in mathematical physics. Many boundary problems have been solved there. It is interesting that Vekua [1-2], solves equation where coefficients $A = A(z, \bar{z})$

and $B = B(z, \bar{z})$ do not have to be analytical functions, but are some function of the space $L_p(G)$, $p > 2$, where G is finite closed region.

In the lines [2-6] are given new, but abbreviated and more practical formulas for solving of equation (1), providing A and B are analytical functions in finite region.

Among other things, it has been shown that general solution of homogenous Vekua equation (1) with analytical coefficients, $w = w_{A,\phi} + w_{B,\phi} + w_{A,B,\phi}$, contains part which only

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